Remarks

Claims 13 through 27 stand rejected under 35 USC 103(a) as being unpatentable over Steeg et. al. '202 in view of Steffens et. al. '218.

In responding to these rejections, the Applicant has redirected the invention to a method for producing a plain bearing composite material in accordance with claim 28 as well as a product by process claim 29 directed to a plain bearing composite material produced by the method of claim 28. The remaining article of manufacture claims have been redirected to product by process claim 29. The Applicant respectfully submits that the claims of record as amended are distinguished from the prior art for the following reasons.

The Steeg patent '202 is directed towards a sliding element having a sliding layer produced by electron beam vapor deposition (see for example abstract, line 7). The purpose of the Steeg invention is to provide for an improved sliding multi-layer structure having a highly loadable sliding element and which can be produced with reduced manufacturing costs to have a long service life while avoiding electroplating methods (see column 1 line 66 through column 2 line 8 of Steeg). Steeg emphasizes that this purpose is achieved by depositing the sliding layer onto a multi-layer substrate using electron beam vapor deposition. Use of the electron beam vapor deposition procedure increases the fatigue limit, in particular, in comparison to electroplating (see Steeg column 2 lines 17 through 19). Steeg attributes this good performance and high loading bearing capacity to the high deposition rate associated with the electron beam deposition method (see Steeg column 2 lines 23 through 29). Steeg proposes a sliding layer comprising AlSn20Cu0.25 (see Steeg column 4 line 7).

Steeg mentions prior art in which the sliding layer is applied by sputtering (see Steeg column 1 lines 36 through 40). However, Steeg considers the sputtering method in need of improvement, stating that the sputtering procedure is expensive and can only provide a limited deposition rate (see Steeg column 1 lines 50 through 53). Steeg considers this low deposition rate to be disadvantageous since, as mentioned above, Steeg views a high deposition rate as leading to a fine distribution of dispersed components and a high load-bearing capacity (Steeg column 2 lines 25 through 28).

Steeg is completely silent concerning the hardness of his sliding layer.

Steffens '281 discloses a crankshaft bearing shell having a plated aluminum sliding layer. The sliding layer is extremely soft, having a Brinell hardness of 45 HB 1/5/30 following heat treatment (see abstract of Steffens lines 5 and 14). The sliding layer of Steffens comprises an AlSn(20-23)Cu(1.8-2.3) alloy (see Steffens paragraph [14] line 4). Steffens states that the improved performance of his crankshaft bearing shell is due to the addition of an increased amount of copper in the range of 1.8 to 2.3 percent in connection with the thermal treatment, since that copper contribution dissolves linear tin deposits produced during rolling and leads to finely distributed tin deposits of a size less than 5 µm following thermal treatment (see Steffens paragraph [15] lines 3 through 13).

One of average skill in the art, aware of the Steeg and Steffens references, would not be motivated to replace the electron beam deposition method of Steeg with a sputtering method as claimed in the instant invention, since Steeg states that the electron beam deposition is superior to sputtering and leads to higher load-bearing capacity. Moreover, one of average skill in the art, aware of the Steeg and Steffens references, would not be motivated to replace the 0.25 percent copper

content of the Steeg sliding layer with the 1.8 to 2.3 percent per weight copper value proposed by Steffens, thereby approaching values claimed in the instant invention, since that change would represent nearly a fact of ten increase in copper content of the alloy composition proposed by Steeg which could lead to an unacceptable brittleness for the resulting sliding layer and reduction in the lifetime thereof. Moreover, Steffens provides no motivation for such a substitution, since Steffens proposes the addition of increased copper in order to dissolve linear tin deposits produced during rolling, a problem which does not occur in the electron beam deposition procedure of Steeg. Therefore, the replacement of the Steeg copper content with the increased values of Steffens could result in reduced performance without solving any of the problems addressed by Steffens, since those problems do not occur in electron beam deposition processes.

Neither the Steeg nor the Steffens references, alone or in combination, provide any motivation for the hardness limitation of claim 28 of between 110 and 150 HV 0.002. Steffens discloses a plated sliding layer which is extremely soft having a Brinell hardness of 45 HB 1/5/30 after heat treatment and Steeg is completely silent concerning the hardness properties of his electron beam deposited sliding layer.

The Examiner's attention is additionally addressed to dependent claim 21 reciting further limitations for the tin content to be between 23 and 27 percent as well as an increased copper content between 2.4 and 2.7 percent. Steffens provides no motivation for these limitations, since the Steffens upper limit merely touches the lower limit of tin content as claimed in claim 21 and thereby fails to teach that range with sufficient specificity. Moreover, Steffens fails to provide motivation for the 2.4 to 2.7 percent limitation as claimed in claim 21, since Steffens discloses an upper bound of 2.3 percent which fails to overlap with the claimed range. Moreover, Steffens provides no motivation to adjust the amounts of tin

and copper to overlap within the claimed range, since Steffens provides no suggestion that these values are result effective within the context of a sputtering process producing the hardness values claimed.

Prior bearing composition materials had attempted to avoid hardness values in excess of 100 HV, since it had been discovered that such hardnesses led to increased brittleness and consequent premature failure of the sliding layer. In accordance with the invention, it has been discovered that, with the addition of AlSn within the claimed range of 22 to 30 percent in accordance with method claim 28 in combination with a copper range of 2.3 to 2.8 percent, an increased hardness can be generated through introduction of the sliding layer by sputtering to achieve a hardness of 110 to 150 HV 0.002 without making the sliding layer material unacceptably brittle. None of the prior art provides any motivation for this combination of elements as claimed, since the prior art of record is completely silent concerning the hardness properties of a layer deposited by sputtering and since that prior art discloses hardness values which are far below the claimed range.

The application as amended is therefore sufficiently distinguished from the prior art of record to satisfy the conditions for patenting in the United States. The remaining dependent claims inherit the limitations of the base claim and are therefore similarly distinguished from that prior art for the reasons given. The Examiner is therefore respectfully requested to review his position concerning this case and to pass this application on to issuance.

No new matter has been added in this amendment.

Respectfully submitted,

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